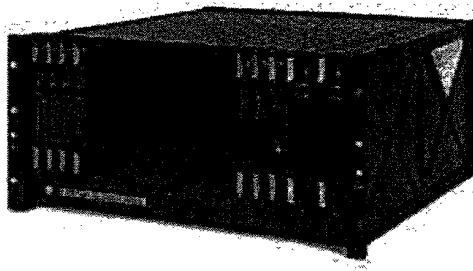




DATA SHEET

Total Control® 1000 Media Gateway



Key Benefits

Increased efficiency

IP networks utilize bandwidth more efficiently than traditional circuit-switched networks. Voice traffic can be compressed to 6 Kbps per call. Even greater efficiency is achieved by using idle bandwidth when voice calls are silent.

Toll-quality voice

Voice-over-IP gives your customers toll-quality voice services equal to that of the PSTN.

Service differentiation

Flexible and open interfaces reduce time to market for new services and let you stay ahead of the competition.

Multiservice platform

A robust multiservice platform supports voice, data, and fax traffic to deliver cost efficiencies. The Total Control® 1000 media gateway is an integral part of the CommWorks IP telephony platform.

It lets you manage voice, data, and fax traffic on a single IP network to deliver simple, cost-effective value-added services.

The Total Control® 1000 media gateway links the circuit-switched telephone network and the packet-switched IP network to carry voice, data, and fax traffic. With it, the CommWorks platform easily integrates into a variety of different environments, providing support for wireless, cable and other access technologies. It supports single and multistage dialing models and seamless connectivity with the signaling system 7 (SS7) network.

- An edge server card set for call processing, signaling, and media gateway controller communication
- A network management card set for platform-wide management and software downloads

Leverage the CommWorks IP telephony platform to offer traditional services, as well as set the stage for delivery of new revenue generating enhanced services

DSP Card Set

The DSP card set includes a T1/E1-PRI and E1-R2 termination point (the T1/E1 NIC) and processing components, the DSP network access card (NAC). It converts PCM to digital voice packets and sends them to the edge server card set for further processing and distribution. This process is reversed at the end of the call.

Features include:

- A digital signal processor (DSP) card set for terminating T1/E1-PRI and E1-R2 service and converting typical circuit-switched voice code into packet data
- G.711, G.729a and b, and G723.1 audio codecs for PCM to voice data conversion
- G168 echo canceller
- Comfort noise generator
- Dynamic jitter buffer to compensate for packet delay and/or lost packets

WIRED

COMMWORKS® TOTAL CONTROL® 1000 MEDIA GATEWAY

- Q.931 ISDN D channel signaling conversion to/from H.225 IP call control
- In-band (H.245) and out-of-band (RFC 2833) DTMF support
- Caller ID support
- T1/E1-PRI, E1-R2 and SS7 signaling

Edge Server Card Set

The edge server card functions as the voice-over-IP (VoIP) gateway router to the IP network. The PCI dual Ethernet NIC provides connectivity to the LAN side of the system. One port is used for network management, the other for call access to the IP network.

A VoIP application running on the edge server card set helps set up calls across the IP backbone. It queries the gatekeeper or SIP proxy server for IP addresses of

remote (egress) gateways and routes calls to the appropriate egress gateway. In turn, the gatekeeper or SIP proxy server handles all call signaling including ISDN transparency, auto registration of the gateway, and initiates the creation of call detail records (CDRs).

Network Management Card

The network management card (NMC) manages the devices installed in the Total Control platform. The NMC is directed by the Total Control manager—the management station.

It can be optionally managed by the CommWorks 5000 for multi-chassis bulk management.

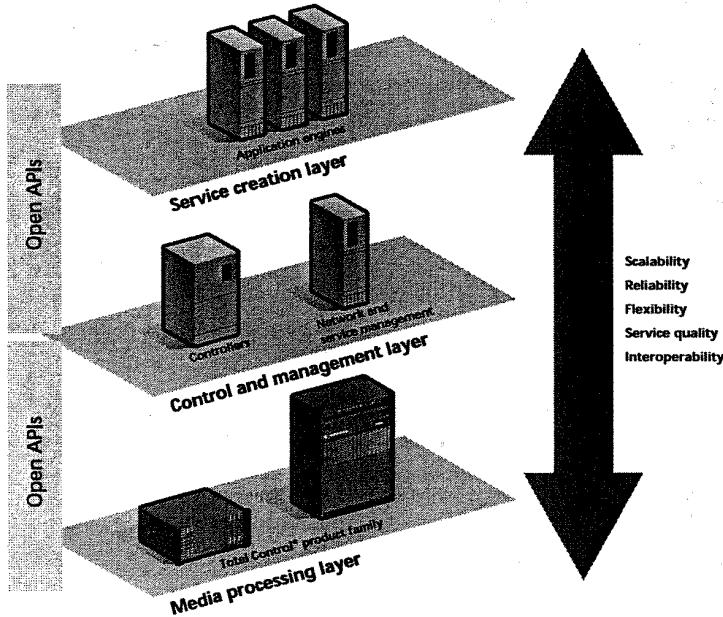
The network management card supports the Simple Network Management Protocol (SNMP) for communication between the NMC and the management station. The NMC acts as a proxy agent for the other NACs in the platform that don't support SNMP directly.

Capabilities of the card as directed by the management system include:

- Configuration queries and updates
- Automatic device recognition and configuration upon installation
- Software upgrades
- Performance monitoring
- Fault management

The NMC also performs event management. Standard SNMP traps can be enabled to send an event notification or trap message to one or more management stations. The management station uses these traps for logging and alarms.

The NMC communicates with the CommWorks 5210 IP telephony manager for Total Control. It is an SNMP-based element management application that allows operators to control, configure, monitor, and test the Total Control 1000 media gateway chassis, the cards within it, and signaling and back-end servers.

**CommWorks 3-Tier Architecture**

The CommWorks three-tier architecture for IP telephony includes a media processing, control and management, and service creation layer. At the media processing layer, the Total Control 1000 media gateway provides universal connectivity at the access level by seamlessly integrating multiple traffic types across disparate networks.

COMMWORKS® TOTAL CONTROL® 1000 MEDIA GATEWAY

The Total Control 1000 Media Gateway Features

Feature	Benefit
Scalability and Capacity <ul style="list-style-type: none"> Gateway scales from 1 to 12 T1s/E1s per chassis 	A virtually unlimited number of gateways per network allows construction of a sizable IP network
Standards-based solution <ul style="list-style-type: none"> Fully SNMP-managed components 	Support for H323v2, SIP SS7, PRI, E1-E2, ODBC, OSP SNMP, aHIT!, and iNOW! ensures interoperability with existing infrastructure, CommWorks partners, and other third party vendors; offers an ANSI compatible interface, low total cost of ownership, efficient back office integration. Reduces time-to-market for new services; allows services to be customized to the needs of individual customers; provides differentiation opportunities; accommodates customized and third-party back-end servers.
Load Sharing and Balancing <ul style="list-style-type: none"> Gatekeeper/SIP proxy server load balancing Advanced network planning 	Provides maximum network uptime and performance; dynamic DSP resource allocation within the gateway and gatekeeper/SIP proxy server load balancing ensures leading scalability; ensures low call setup time by sharing the load in the network; provides flexible preprovisioning of traffic planning and management capabilities with integrated Web-based tools on the Web provisioning server; advanced software tools can be used to evaluate and tune latency, packet loss, network jitter, and delay.
Quality of Service (QoS) Enhancements <ul style="list-style-type: none"> Supports three classes of traffic G.168 compliant echo cancellation Comfort noise generator Latency management Less than one second call setup delay G.711 with frame erasure concealment mechanism to optimize fax and data transmission G.723.1, G.729 a and b voice compression H.2435 and RFC 2833 out of band DTMF support Dynamic jitter compensation Silence Suppression 	Supports RTP voice packet traffic to/from DSP, H.323 v2, and SIP signaling traffic (H.225 RAS, H.245, Q.931); supports G.723.1 and G.729a and b voice compression; provides the most current and stringent echo cancellation standard for delivering toll-quality voice; ensures optimal voice quality for the IP network; simulates background noise during silence suppression; also provides smoother sound with minimal delay; guarantees unimpeded transport through the gateway for all real-time traffic; further reduces delay caused by the RTP overhead; delivers increased bandwidth efficiency and toll quality.
Reliability and Availability <ul style="list-style-type: none"> Dynamic auto zone configuration Less than 100 defects per million calls Real-time and historical reporting Gateway self recovery Gatekeeper clustering within a zone 	Dynamically reconfigures a gatekeeper zone to account for traffic changes and perform disaster recovery in the event of nodal failures; comparable with today's stringent PSTN reliability requirements; manages all the IP telephony elements; HP OpenView can be used to monitor the status of all system elements and integrate CommWorks' IP management with a provider's management solution to simplify overall network management and administration; minimizes system outage; ensures tier 2 and tier 3 resiliency.
Redundancy and Fault Tolerance <ul style="list-style-type: none"> Gateway fault management Gatekeeper redundancy Back-end server redundancy Gateway availability in power outage 	Creates a robust platform that ensures no loss of quality or performance for the end user; supports redundant primary and secondary gatekeepers per zone, which prevents any service disruption in the overall network due to gatekeeper failure; support for primary to secondary server automatic failover prevents any service disruption in the overall network due to back-end server failure; dual DC load-sharing power supplies and fault management prevent any service disruption in the network due to gateway power failure.
Service Transparency <ul style="list-style-type: none"> No quality degradation End-to-end Q.931 signaling transparency 	Seamlessly hands off traffic from the PSTN to the IP network and is completely transparent to end users with transparent pass through of voice calls, 33.6 Kbps fax calls, and V.90/V.92 voice band modem calls; enables transparent support of CLASS services such as caller ID.
Seamless PSTN Integration <ul style="list-style-type: none"> E.164 numbering plan support SS7, T1/E1/PRI and E1-R2 signaling PSTN in-band and out-of-band DTMF support 	Enables integration of the system globally; supports call origination and termination in countries not using NANP; enables customization of the directory server to support call origination and termination with country-specific dialing plans; provides an efficient avenue for building scalable solutions with SS7 interoperability, making VoIP signaling more reliable; G.711, G.723.1, and G.729a and b codecs provides complete transparency to end users.
Security <ul style="list-style-type: none"> Gateway registration and back-end server SNMP access control 	Provides secure transmission for mission-critical information and prevents unauthorized access to system; firewall access security protection of back-end servers; limits access to SNMP device control.
Advanced OAM&P <ul style="list-style-type: none"> Automated software installation and upgrades Maintenance diagnostics 	Allows network operator to easily install and upgrade the network remotely from the network operations center; ensures each connection is functioning properly.

TOTAL CONTROL 1000 MEDIA GATEWAY

Specifications**Gateway**

- Fault tolerance on gateway PRI and IP interfaces
- Supports hot-standby mode
- Recovery procedures for system components including loss of IP connectivity
- Scalability and performance
- Full load capabilities of up to 360 simultaneous calls per shelf* (30 ports x 12 HDMs)
- Call setup delay less than 1 second
- Voice transfer delay less than 100 ms

Hardware/Software Requirements

Hardware requirements are static and cannot be altered. The edge server card set must be used for the media gateway. Minimum software requirements must be met, but optional software can be added as needed.

DSP Cards

Hardware: Each card supports one T1/E1 trunk

Each shelf supports up to 12 T1/E1 trunks for connectivity to the PSTN

Edge Server Cards

Hardware: Each shelf supports multiple cards

- 450MHz processor
- 256 MB RAM
- PCI dual 10/100 Ethernet NIC

Network Management Card (NMC)

- Hardware: one per shelf
- Unified management interface for all gateway functions
- SNMP access and security

Dual Power Supplies

- Provide 130 A including both DC and/or AC power to the unit

DSP Features

- G.711, G.723.1, G.729a and b
- H.245 in-band DTMF support for G.711
- RFC 2833 out-of-band DTMF support for G.723.1 and G.729 a and b
- G.168-compliant echo cancellation
- Silence suppression via voice activity detection and comfort noise generation (VAD/CNG)
- Multiple audio frames per RTP packet
- Configurable packet payload size

PSTN Signaling/Interfaces

- Supports 105 and 108 test function for on-demand loopback testing
- SS7, T1/E1-PRI, and E1-R2

IP Signaling

- H.323 v2 with fast start
- H.225 RAS, and H.245 media gateway controller routed model
- H.450 business services
- SIP RFC 2543 compliant

IP Fax

- Real-time fax-to-fax pass through via C.711 or T.38 for G.723.1 and G.729 a and b
- Voice/fax /data type detection

H.323 Support

- All mandatory features of H.323-v2.
- H.323-v2 optional features—globally unique identifier for each call, fast start
- H.225/Q.931 signaling-compliant gateway-to-gateway communication
- Interzone communications

SIP Support

Complies with RFC 2543



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Exhibit C-3



CommWorks IP Telephony

Overview Guide
Release 2.3
Part Number 10044866

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ABOUT THIS GUIDE

About This Guide contains an overview of this guide, describes where to find specific information, lists conventions and related documentation, and explains how to contact CommWorks.

This guide provides an overview of the CommWorks IP Telephony platform and explains how to plan to its installation.

The Overview part of this guide is intended for all telecommunications personnel, including system engineers and planners, developers, operational personnel, testers, and field support. The Planning and Technical Specifications parts are aimed primarily at system engineers and planners, and operations personnel.



Release notes are issued with some products—visit our website at [http://totalservice@commworks.com](mailto:totalservice@commworks.com). If the information in the release notes differs from the information in this guide, follow the instructions in the release notes.

Finding Information

The following table lists where to find information in this guide.

Table 1 Finding Information

If you are looking for	Go to
Overview of system components and how they interact	Chapter 1
Call flow diagrams	Chapter 2
IP addressing guidelines	Chapter 3
Technical specifications	Chapter 4
Glossary	Appendix A



ABOUT THIS GUIDE

Conventions

These tables list conventions used throughout this guide.

Table 2 Notice Conventions

Icon	Notice Type	Description
	Information note	Information that contains important features or instructions.
	Caution	Information to alert you to potential damage to a program, system, or device.
	Warning	Information to alert you to potential personal injury or fatality. May also alert you to potential electrical hazard.
	ESD	Information to alert you to take proper grounding precautions before handling a product.

Table 3 Text Conventions

Convention	Description
Text represented as a screen display	This typeface represents displays that appear on your terminal screen, for example: Netlogin .
Text represented as commands	This typeface represents commands that you enter for example: setenv TCMHOME directory <i>This guide always gives the full form of a command in uppercase and lowercase letters. However, you can abbreviate commands by entering only the uppercase letters and the appropriate value. Commands are not case-sensitive.</i>
Text represented as menu or sub-menu names.	This typeface represents all menu and sub-menu names within procedures, for example: On the File menu, click New .

Related Documentation

The following documents contain information about the components of the CommWorks IP Telephony Platform:

- CommWorks IP Telephony System Software Installation Guide
- CommWorks IP Telephony Overview Guide
- CommWorks IP Telephony Hardware Installation Guide
- Total Control 1000 Media Gateway Guide
- CommWorks 4200 Gatekeeper Guide
- CommWorks 4220 SIP Proxy Server Guide
- CommWorks 7220 Accounting Server Guide
- CommWorks 7230 Billing Support Server Guide
- CommWorks 7210 Directory Mapping Server and CommWorks 7240 Web Provisioning Server Guide

Contacting CommWorks xi

- CommWorks 5210 IP Telephony Manager Guide (1000 Platform)
- CommWorks IP Telephony Parameter (MIB) Reference Guide
- CommWorks IP Telephony Trap (Alarm) Reference Guide
- CommWorks 4007 SS7 Signaling Gateway Operation and Maintenance Guide

Contacting CommWorks

This section describes how to contact CommWorks Technical Support.

Before contacting CommWorks Technical Support, have this information available:

- Contract number
- Problem description
 - Symptoms
 - Known causes
- CommWorks products
 - Software and hardware versions
 - Serial numbers
- Trouble clearing attempts



For information Customer Service, including technical support telephone numbers, training, code releases and updates, contracts, and documentation, visit our website at <http://totalservice@commworks.com>.

1

SYSTEM OVERVIEW

This chapter contains overview information for the CommWorks IP Telephony Platform.

This chapter contains the following topics:

- [CommWorks IP Telephony Platform](#)
- [CommWorks IP Telephony Media Gateway](#)
- [H.323 Gatekeeper](#)
- [SIP Proxy Server](#)
- [Back-end Servers](#)
- [SNMP Management Subsystem](#)
- [Real-time Media Gateway Operating Statistics](#)
- [Management Workstations](#)
- [Other Features](#)



Unless otherwise specified, this document uses the generic term edge server to refer to either the EdgeServer Pro card or the edge server card.

CommWorks IP Telephony Platform

The CommWorks IP Telephony Platform is a system of hardware and software components that route telephone calls over an IP-based network. Routing calls over IP provides an alternative infrastructure to that of traditional long-distance service. It is cheaper and more efficient and is a step toward creating a single network for carrying voice, modem, and fax traffic.

For network ingress, a Telco switch at a point-of-presence connects to a CommWorks IP Telephony Media Gateway via one of the following:

- T1 Primary Rate Interface (PRI)
- T1 Inter-machine Trunk (IMT) when used with SS7 signalling
- E1 Primary Rate Interface (PRI)
- E1/R2 Multifrequency Compelled (MFC) signalling
- E1 Inter-machine Trunk (IMT) when used with SS7 signalling

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When the Media Gateway is enabled for SS7 signalling, the Media Gateway uses E1 IMT, or T1 IMT, connections to the Telco switch and signalling is done over an IP network to an SS7 signalling Gateway.

Voice, modem, facsimile, and call-control traffic flows over an IP network to an egress CommWorks IP Telephony Media Gateway. The egress Gateway connects to a Telco switch at the central office of the local exchange carrier (LEC).

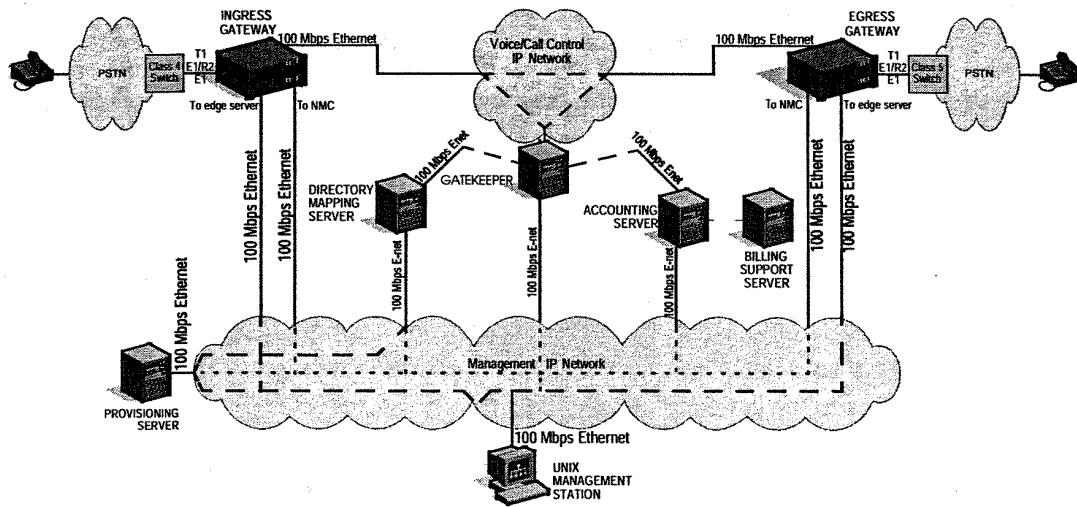
The CommWorks IP Telephony network is packet-switched and no fixed connections are made between points; analog voice is converted to digital data and travels across the network in small packets that are reassembled by the destination Media Gateway. The CommWorks platform is more efficient than traditional systems because a circuit is not held open for the duration of the call and packets flow only when there is voice information to transmit.

The diagram on the next page shows the components of the CommWorks IP Telephony Platform and how they interact.

Components include:

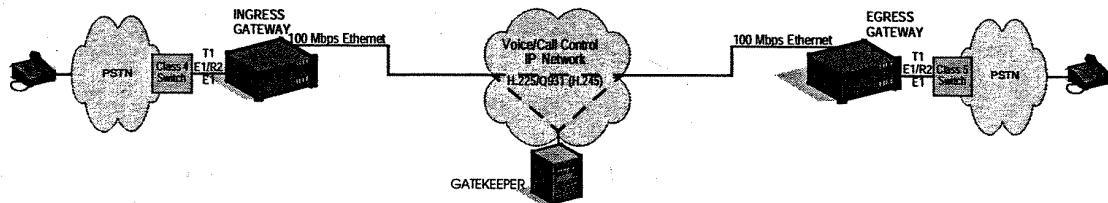
- Media Gateway
- Proxy Server (SIP)
- Gatekeeper (H.323 applications)
- Back-end Servers: Directory, Billing Support, and Accounting
- Provisioning Server (the Web-based interface to the Back-end Servers)

Figure 1 CommWorks IP Telephony Platform



Basic Traffic Flow When a call is connected, voice, modem, or fax traffic flows between the ingress and egress Gateways.

Figure 2 Traffic Flow During Call Connection



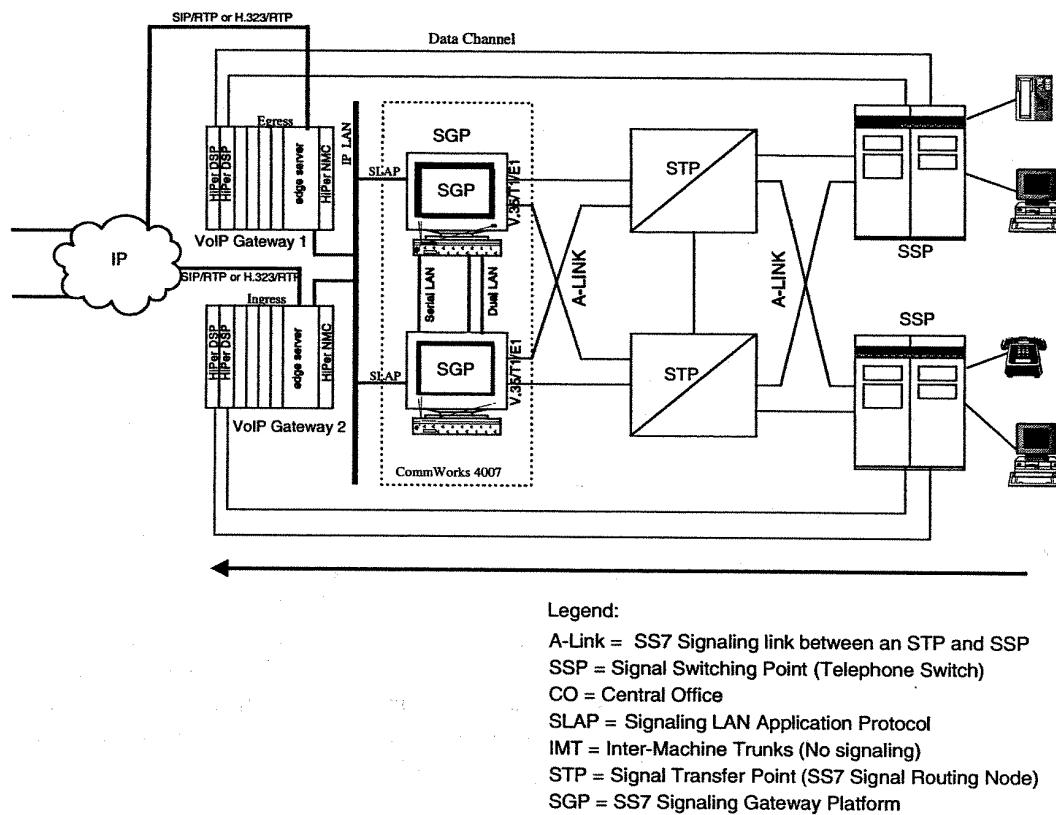
Audio traffic generated at the ingress side flows from a Telco switch over an E1 line to a HiPer Digital Signal Processor (DSP) card in the CommWorks IP Telephony Media Gateway. The HiPer DSP codes the audio in G.711 or G.723.1 format and then sends the audio over a packet bus in the Media Gateway to an CommWorks edge server voice card. The edge server card sends the audio through its 100-Mbps ethernet interface over an IP network to an egress Gateway.

Between the Media Gateways, data flows according to the Real Time Protocol (RTP), over the User Datagram Protocol (UDP) over IP.

At the egress Gateway, the edge server card receives the audio through its 100-Mbps Ethernet port and sends it over the internal packet bus to a HiPer DSP card. The HiPer DSP card decodes the packets and sends the audio over a channel in an E1 line to a Telco switch and then to the egress destination.

Traffic Flow with SS7 Enabled

The following diagram illustrates the flow of a call in the VoIP with SS7 network.

Figure 3 VoIP and SS7 (Ingress or Egress) Network Detail Diagram

As illustrated above starting from the right, a request for service may be initiated by an analog telephone, referred to as a POTS, or a data/FAX modem connected to a POTS line. A POTS request for service is received by a Signal Switching Point (SSP) or PSTN switch, at a telephone service provider central office. The SSP switch has SS7 signalling trunks carrying the call signalling information, (shown as 'A' links) and payload-carrying trunks carrying the voice/data call (shown as 'IMT'). The SSP (switch) uses a signalling message over an 'A' link towards the STP to signal a new call attempt. (The STP acts like a router that switches the signalling messages to the appropriate destination.)

The SSP switch receives an incoming call and selects an idle DS0 to setup the call to Total Control 1000. The signalling message from the SSP switch specifies the specific payload-carrying DS0 trunk (a member of the IMT group) that the SSP switch has reserved for the new call. The STP routes the new call signalling message to the SS7 Gateway. The signalling messages use the ISUP protocol.

The SS7 signalling Gateway (SG) translates the ISUP message to a SLAP message, and transports it over an IP network or private LAN to the appropriate Total Control 1000 that terminates the reserved IMT group member. The Total Control 1000 interprets the SLAP signalling message and associates it with the reserved IMT trunk group member (DSO). It then processes the call setup request just like it processes an ISDN PRI D-channel signalling message. The HiPer DSP performs RTP packetization. The edge server routes the RTP packets over the IP network used to transport the telephony data.

SLAP Protocol The SS7 Gateway uses the signalling LAN Application Protocol (SLAP) to link the SS7 network to the Total Control Hub. SLAP is the interface between the Total Control Chassis (VoIP Gateway) and the external SS7 Gateway system. See Figure 3. It replaces the D-channel signalling that normally exists in an ISDN PRI interface and also defines the messages to facilitate system start up, shut down, and error recovery. SLAP is CommWork's proprietary software and is supported by several signalling Gateway vendors.

**CommWorks IP
Telephony Media
Gateway**

The CommWorks IP Telephony Media Gateway is a specially equipped Total Control multiservice access unit that interconnects the public switched telephone network (PSTN) with an IP-based network.

A Media Gateway processes all voice calls in real time. It converts pulse-code modulation (PCM) data into voice-packet data, requests destination addresses, and sends signalling information to the local central offices (COs) on both ends of the call. A Media Gateway mediates between the circuit switched telephone network and the packet switched IP network.